CLAIMS

The invention claimed is:

1. A method of forming a layer of material on a substrate, comprising:

providing a substrate within a reaction chamber;

providing a mixture within the chamber, the mixture comprising a precursor of a desired material within a supercritical fluid, the mixture initially being provided in the chamber under first conditions at which the precursor is stable;

after the mixture is within the chamber, and while maintaining the supercritical state of the supercritical fluid, changing the conditions of at least some of the mixture to second conditions under which the stability of the precursor is altered relative to the first conditions; the precursor reacting under the second conditions to form the desired material; and

at least some of the desired material forming a layer on the substrate.

2. The method of claim 1 wherein the precursor is a first precursor and is one of two or more precursors of the desired material which are provided in the reaction chamber.

3. The method of claim 1 wherein the precursor is a first precursor and is one of two or more precursors of the desired material which are provided in the reaction chamber, and wherein the first precursor reacts with the other precursors to form the desired material.

4. The method of claim 1 wherein the second conditions comprise a different temperature than the first conditions.

5. The method of claim 1 wherein the reaction of the precursor to form the desired material occurs entirely in the mixture; and wherein the desired material transfers from the mixture to the substrate to form the layer on the substrate.

6. The method of claim 1 wherein the reaction of the precursor to form the desired material occurs at an interface of the supercritical phase and a surface of the substrate.

7. The method of claim 1 wherein the substrate has surface composition, and wherein the precursor reacts with the surface composition under the second conditions to form the desired material as the layer on the substrate.

8. The method of claim 1 wherein the substrate is a semiconductor substrate.

9. The method of claim 1 wherein the precursor comprises silicon and oxygen, and wherein the desired material is silicon dioxide.

10. The method of claim 9 wherein mixture initially provided in the reaction chamber consists of the precursor and a portion of the mixture other than the precursor; and wherein the portion of the mixture other than the precursor consists essentially of supercritical carbon dioxide.

11. The method of claim 1 wherein the precursor comprises nitrogen and titanium, and wherein the desired material is titanium nitride.

12. The method of claim 1 wherein the precursor comprises tetrakis-(dimethylamido)titanium, and wherein the desired material is titanium nitride.

13. The method of claim 1 wherein the precursor comprises nitrogen and tantalum, and wherein the desired material is tantalum nitride.

14. The method of claim 1 wherein the precursor comprises pentakis-(dimethylamido)tantalum, and wherein the desired material is tantalum nitride.

15. The method of claim 1 wherein the precursor comprises oxygen and hafnium, and wherein the desired material is hafnium oxide.

16. The method of claim 1 wherein the precursor comprises hafnium tert-butoxide, and wherein the desired material is hafnium oxide.

17. A method of forming a layer of material on a substrate, comprising:

providing a substrate within a reaction chamber;

providing a mixture within the chamber, the mixture comprising a precursor of a desired material within a supercritical fluid, the precursor being reactive at or above a threshold temperature to form the desired material, the mixture being initially provided within the reaction chamber at a temperature below the threshold temperature;

raising the temperature of at least some of the mixture to a temperature at or above the threshold temperature to form the desired material from reaction of the precursor; and

at least some of the desired material forming a layer on the substrate.

18. The method of claim 17 wherein the reaction of the precursor to form the desired material occurs entirely in the mixture; and wherein the desired material transfers from the mixture to the substrate to form the layer on the substrate.

19. The method of claim 17 wherein the reaction of the precursor to form the desired material occurs at an interface of the supercritical phase and a surface of the substrate.

20. The method of claim 17 wherein the substrate has surface composition, and wherein the precursor reacts with the surface composition at or above the threshold temperature to form the desired material as the layer on the substrate.

21. The method of claim 17 wherein the temperature of the mixture is raised by heating the substrate and transferring heat from the substrate to the mixture.

22. The method of claim 17 wherein the substrate is a semiconductor substrate.

23. The method of claim 17 wherein the precursor comprises silicon and oxygen, and wherein the desired material is silicon dioxide.

24. The method of claim 17 wherein the precursor is tetraethyl orthosilicate and wherein the desired material is silicon dioxide.

25. The method of claim 24 wherein mixture initially provided in the reaction chamber consists of the precursor and a portion of the mixture other than the precursor; and wherein the portion of the mixture other than the precursor consists essentially of supercritical carbon dioxide.

26. The method of claim 17 wherein the precursor comprises nitrogen and titanium, and wherein the desired material is titanium nitride.

27. The method of claim 17 wherein the precursor comprises tetrakis-(dimethylamido)titanium, and wherein the desired material is titanium nitride.

28. The method of claim 17 wherein the precursor comprises nitrogen and tantalum, and wherein the desired material is tantalum nitride.

29. The method of claim 17 wherein the precursor comprises pentakis-(dimethylamido)tantalum, and wherein the desired material is tantalum nitride.

30. The method of claim 17 wherein the precursor comprises oxygen and hafnium, and wherein the desired material is hafnium oxide.

31. The method of claim 17 wherein the precursor comprises hafnium tert-butoxide, and wherein the desired material is hafnium oxide.

32. A method of forming a layer of material on a substrate, comprising:

providing a substrate within a reaction chamber;

providing a mixture within the chamber, the mixture comprising a precursor within a supercritical fluid; at least a portion of the substrate having a surface which is reactive with the precursor under particular conditions to form a material on the surface; and

subjecting at least a portion of the mixture to the particular conditions to form the material on the substrate surface.

33. The method of claim 32 wherein the reactive portion of the substrate surface comprises a catalyst which reacts with the precursor.

34. The method of claim 32 wherein:

the mixture is initially provided within the reaction chamber at conditions other than the particular conditions; and

while the mixture is within the reaction chamber, the conditions of at least the portion of the mixture are changed to the particular conditions to form the material on the substrate surface.

35. The method of claim 34 wherein the changing of the conditions of at least the portion of the mixture to the particular conditions comprises raising a temperature of at least the portion of the mixture.

36. The method of claim 34 wherein the surface of the substrate comprises tetramethylaluminum, the precursor comprises tris(tert-butoxy)silanol, the material formed on the substrate surface comprises silicon dioxide, and the changing of the conditions of at least the portion the mixture comprises raising a temperature of at least the portion of the mixture.

37. The method of claim 36 wherein the substrate comprises monocrystalline silicon.

38. The method of claim 36 wherein the material consists of silicon dioxide and is formed to a thickness of less than or equal to 100Å.

39. The method of claim 36 further comprising:

after forming the material comprising silicon dioxide on the substrate surface, forming a second layer of tetramethylaluminum on the silicon dioxide; and

exposing the second layer of tetramethylaluminum to tris(tert-butoxy)silanol in a supercritical fluid under the particular conditions to form a second material comprising silicon dioxide over the first material comprising silicon dioxide.

40. A method of forming at least one trenched isolation region, comprising:

providing a semiconductor substrate within a reaction chamber, the substrate having at least one trench extending therein;

providing a mixture within the chamber, the mixture comprising a precursor of an electrically insulative material within a supercritical fluid, the precursor being reactive at or above a threshold temperature to form the electrically insulative material, the mixture being initially provided within the reaction chamber at a temperature below the threshold temperature; and

raising the temperature of at least some of the mixture to a temperature of at least the threshold temperature to form the electrically insulative material within the at least one trench.

41. The method of claim 40 wherein the reaction of the precursor to form the electrically insulative material occurs entirely in the mixture; and wherein the electrically insulative material transfers from the mixture to the substrate to form the layer on the substrate.

42. The method of claim 40 wherein the reaction of the precursor to form the electrically insulative material occurs at an interface of the supercritical phase and a surface of the substrate.

43. The method of claim 40 wherein the substrate has surface composition, and wherein the precursor reacts with the surface composition at or above the threshold temperature to form the electrically insulative material as the layer on the substrate.

44. The method of claim 40 wherein the temperature of the mixture is raised by heating the substrate and transferring heat from the substrate to the mixture.

45. The method of claim 40 wherein the substrate is a semiconductor substrate.

46. The method of claim 40 wherein the substrate comprises monocrystalline silicon.

47. The method of claim 40 wherein the precursor comprises silicon and oxygen, and wherein the electrically insulative material is silicon dioxide.

48. The method of claim 40 wherein the precursor is tetraethyl orthosilicate, and wherein the electrically insulative material is silicon dioxide.

49. The method of claim 40 wherein the precursor is tris(tert-butoxy)silanol, and wherein the electrically insulative material is silicon dioxide.